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BRAGA / PORTUGAL /

INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY / **INL**

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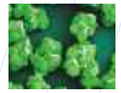
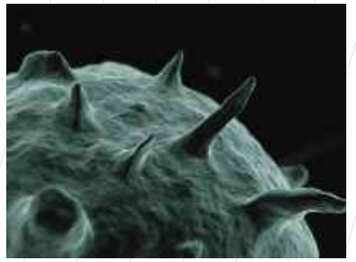




The Decision to Create a joint Portugal-Spain R&D Laboratory

Leading on New Institutional Partnerships in Science and Technology in Europe

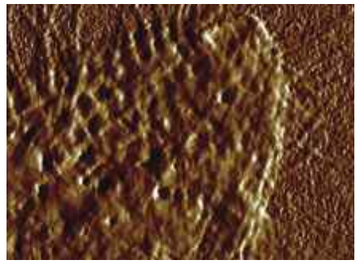
The decision of Portugal and Spain to create an International Research Laboratory was announced in November 19, 2005 by the heads of Government of both countries —the President of the Government of Spain José Luis Zapatero and the Prime Minister of Portugal José Sócrates —at the end of the XXI Portugal-Spain Summit that took place in Évora, as the major decision taken at this summit.

With this decision, the Governments of Portugal and Spain made clear their commitment to a strong cooperation of both countries in ambitious science and technology joint ventures.

As announced then, the International Iberian Nanotechnology Laboratory (INL) will be installed in Braga, Portugal, having as first director the Spanish professor José Rivas and will count with 200 researchers to be recruited all over the world, aiming at international excellence.

This new laboratory will be set up as a fully international research organization open to the membership of other European countries and other regions of the world.

The decision was received with special interest in the European Union by the Commission and several of the other Member States. It was selected as one of the best practice cases to be presented in the first workshop of best practices on the Lisbon Agenda held on October 6, 2006 in Lisbon.



Internationally Attractive Conditions

A Favourable Setting for Working at the Forefront of Knowledge

The International Iberian Nanotechnology Laboratory (INL) results from an ambitious decision of Portugal and Spain to create especially attractive conditions for top researchers to work at the forefront of knowledge in a challenging environment, namely:

- The openness, special visibility, stability and flexibility of the decision making process brought by the statute of an international research organization.
- The guarantee of a long-term financial commitment of two Governments assuring, on equal parts, public funds on the order 30 million euros for the operational budget of each year, plus 30 million euros installation investment.
- The commitment of the two Governments to fund a Laboratory with a scientific staff of about 200 researchers.
- The commitment to recruit the scientific staff globally, on a merit basis.
- The guarantee of assuring internationally competitive salaries and benefits.
- The assurance of immigration and family regrouping facilitation provided by the international organization status.
- The prospect that about 30% of the scientific positions be tenure track.
- The provision of a permanent pool of young talent through post-doctoral positions and PhD student fellowships to be awarded on a globally competitive basis.
- The liveliness of permanent contact with advancements going on in other laboratories worldwide, through an ambitious visitors program.
- The challenge of working competitively in a highly interdisciplinary area of research at the frontier of knowledge in a community of people from different disciplines, institutional backgrounds and nationalities.
- A framework for a close relationship with the industrial and other economic sectors, due the flexibility provided by the international organization status, allowing for innovative and efficient networking.
- The possibility of directly establishing international relations with other States and other International Organizations. The guarantee of a continuous scientific strategy orientation by an international committee of the highest standing.
- The possibility of working in an especially attractive environment, both from the quality of space and the social support viewpoints.

Concentration on Nanoscale Science and Technology

A Natural Area of S&T for Innovative International Cooperation Ventures

The details of the implementation and operation of the International Iberian Nanotechnology Laboratory (INL) were defined on the basis of a proposal prepared by a Technical Committee involving representatives of the Knowledge Society Agency (UMIC), the Science and Technology Foundation (FCT), the Science and Higher Education International Bureau (GRICES) on the part of the Ministry of Science, Technology and Higher Education of Portugal, and the Secretariat-General for Scientific and Technological Policy, the Directorate General of Research (DGI) and the Directorate General of Technological Policy (DGTP) of Spain.

"Nanotechnology is the builder's final frontier"
Richard Smalley
Nobel laureate 1996

It was agreed that the Laboratory should concentrate on nanotechnology, and consider applications to several other areas, following a truly interdisciplinary approach. The scientific scope of its activities should include both fundamental and applied aspects, and experimental and theoretical approaches. Besides, the Laboratory should be conceived to:

- assure world class research excellence in all areas of activity;
- develop partnerships with the industry and foster the transfer of knowledge into economic value and jobs;
- train researchers and contribute to the development of a skilled workforce for the nanotechnology industry;
- survey, prevent and mitigate nanotechnology risks.

It was emphasized that the Laboratory should set a clear example of a new type of research collaboration between European Union Member States, and foster the international cooperation with other regions, namely North America, Latin America and certain Asian states.

It was also emphasized that the recruitment of human resources should be done carefully and ambitiously to assure top class level research teams from the very beginning, and guarantee immediate high reputation, enhancing the capability of further attracting top scientists and talented graduate students.

The Portuguese Minister of Science, Technology and Higher Education —José Mariano Gago —participated in the initial part of the Technical Committee first meeting, in Madrid. In declarations to the press afterwards, he highlighted that "the ambition of both countries is to create a research site with world scale relevance, capable of attracting scientists and technicians from all points of the world". He referred that when in full operation the Laboratory can be an attractor for many nanotechnology enterprises to settle and develop in the Iberian Peninsula. He said:

"It will be a Laboratory where many specialists will pass through who will later be sought after by enterprises for working with them; many of them will leave the Laboratory to create their own companies and this will bring an enormous competitive advantage to Portugal and Spain in this sector."

It was also decided to create an Iberian Capacity Building Program in Nano Science and Technology, associated with the INL but reaching all Iberian space, to be initiated at the end of 2006.

Several proposals for location of the laboratory were considered by the Technical Committee, leading to the selection of a land parcel of about 47,000 m2 in Braga, close to the university campus of Gualtar, to be provided by the Braga Municipality. The University of Minho made available space at one of its historic buildings in the centre of Braga for the Laboratory Installation Commission. The Technical Committee also welcomed the idea of installing a Ciência Viva Center to be built next to the Laboratory for the promotion of the public awareness of nano science and technology.

It should be noted that in June 2005, the European Commission had adopted the Communication Nanosciences and Nanotechnologies (N&N): An action plan for Europe 2005-2009. In the background section of this Communication we can read:

"Advances across a wide range of sectors are being enabled through R&D and innovation in N&N. These advances can address the needs of citizens and contribute to the Union's competitiveness and sustainable development objectives and many of its policies including public health, employment and occupational safety and health, information society, energy, transport, security and space."

Nanotechnology has the potential to profoundly change our economy and to improve our standard of living, similarly to the impact information technology had in the past two decades. Numerous products featuring unique properties of nanoscale materials are already available to consumers and industry today. Most computer hard drives, for instance, contain giant magnetoresistance (GMR) heads that, through nano-thin layers of magnetic materials, allow for a significant increase in storage capacity. Some other current uses that are already in the marketplace include catalysis, coatings for easier cleaning or glare-reducing. It is likely that solar cells can be significantly improved with nanotechnology. The pharmaceutical and chemical industries are also being impacted by nanotechnology, both on advanced drug delivery systems and medical diagnostic tools.

"If I were asked for an area of science and engineering that will most likely produce the breakthroughs of tomorrow, I would point to nanoscale science and engineering"
Neal Lane
Former Assistant to the President of the USA for Science and Technology and former Director of the White House Office of Science and Technology

Nowadays it is clear that nations most actively participating in the international effort to harness nano science and technology, will benefit earlier and to a greater extent from their benefits, and will be able to play a leading role on the scientific, technical and economic cooperation with other advanced regions as well as with less developed nations in Latin America and Asia.

The International Advisory Board

Knowledgeable and Credible Advice

A research laboratory in the forefront of knowledge and technology needs advice of leading experts in its field. The following experts already accepted to serve on the International Advisory Board of the International Iberian Nanotechnology Laboratory:

Roberto G.M. Caciuffo
Laurea (cum laude) in Nuclear Engineering, Torino, Italy
PhD (cum laude) in Solid State Physics, Parma, Italy
Head Actinide Research
European Commission Directorate General Joint Research Centre, Institute for Transuranium Elements, Postfach 2340, D-76125 Karlsruhe, Germany

Thomas Jovin
B.S. California Institute of Technology, Pasadena, CA, USA
M.D. Johns Hopkins Medical School, Baltimore, MD, USA
Scientific Member, Max Planck Society
Head of Department of Molecular Biology
Max-Plank Institute for Biophysical Chemistry, Am Fassberg 11, 37077 Göttingen, Germany

Emilio Mendez
PhD Massachusetts Institute of Technology, USA
Prize Príncipe de Asturias of Scientific and Technical Research 1998
Since 1 November 2006 Director of the recently created Center for Functional Nanomaterials, one of the five nanocenters funded by the USA Departement of Energy which is being built at the Brookhaven National Laboratory to start operation in April 2007
Undergraduate Program Director, Department of Physics and Astronomy, State University of New York at Stony Brook Nicholls Road, Stony Brook,
NY 11794-3800, USA

Christopher B. Murray
B.Sc. Saint Mary's University, Halifax, Nova Scotia, Canada
PhD Massachusetts Institute of Technology, USA
American Chemical Society's Nobel Laureate Signature Award in 1997
Woodward Fellow by Harvard University 's Chemistry Department in 2004 Debye Chair Professor, University of Utrecht , the Netherlands in 2004
Manager, Nanoscale Materials and Devices, IBM Corp, T. J. Watson Research Ctr. (Rm 20-108), P.O. Box 218, 1101 Kitchawan Rd, Yorktown Heights NY 10598, USA

Aristides A. G. Requicha
Electrical Engineer, Instituto Superior Técnico, Technical University of Lisbon, Portugal
Ph.D. Electrical Engineering, University of Rochester, USA
Gordon Marshall Professor of Computer Science and Electrical Engineering Director of the Laboratory for Molecular Robotics, nominated in November 2006 as Editor Chief of the IEEE Transactions on Nanotechnology
Computer Science Department, University of Southern California, 941 Bloom Walk, Los Angeles, CA 90089-0781, USA

Mihail C. Roco
PhD, Received the Carl Duisberg Award in Germany, the Burgers Professorship Award in the Netherlands, the Engineer of the Year Award (twice: 1999 and 2004) by the US National Society of Professional Engineers and NSF
Was one of the main architects of the US National Nanotechnology Initiative
Chair of US National Science and Technology Council's subcommittee on Nanoscale Science, Engineering and Technology and Coordinator of the NSF initiative Grant Opportunities for Academic Liaison with Industry
Senior Advisor for Nanotechnology
National Science Foundation
4201 Wilson Boulevard, Suite 505, Arlington, Virginia 22230, USA

Heinrich Rohrer
Nobel Prize in Physics 1986 for the invention, with Gerd Binnig, of the Scanning Tunnelling Microscope while working at the IBM Zürich Research Laboratory
Rebbergstr. 9d, CH 8832 Wollerau, Switzerland

The Scientific Program

According to the assignment of the first Technical Committee meeting, the following report on the scientific program for the International Iberian Nanotechnology Laboratory was prepared under the responsibility of professors José Rivas (U. de Santiago de Compostela) and Paulo Freitas (Instituto Superior Técnico and Instituto de Engenharia de Sistemas e Computadores, Microsistemas e Nanotecnologias - INESC MN, Lisbon).

Introduction

The INL is an international laboratory created to foster interdisciplinary research in Nanotechnology and Nanoscience. It will provide a state-of-the-art research environment promoting an interdisciplinary effort in addressing the major challenges in the emerging areas of Nanobiotechnology, Nanoelectronics, Nanomedicine, and Materials Science at the Nanoscale. The key research activities are based on existing areas of excellence in Portugal and Spain, as well as on new strategic development areas where PIs (Principal Investigators) will be hired. Key to its success will be the quality of the PIs initially hired. The combination of an appropriate level of available research funds, internationally competitive salaries, a state-of-the-art research facility, and the possibility of permanent research positions (about 30% of staff) will be major factors in attracting leading scientists and young and promising researchers to join the founding research team of INL.

The INL will seek strong collaborations with industrial partners and academic research institutions, through a vigorous participation in international research programs, in particular through projects of the 7th Framework Program of the European Union, and by promoting joint post-graduate education programs with major universities. The INL will further foster the creation of spin-off companies in competitive nanotechnology areas, and will manage a strong program in public outreach, popularizing nanoscience and strategic nanotechnology, approaching mass media, science and technology museums, foundations, and publishers. Last, but not least, the INL will address ethical questions concerning the societal impact of nanotechnology.

Study group

This document took into account most of the recommendations of the INL International Advisory Board. It also received input from selected researchers of Portuguese and Spanish laboratories in the area of nano science and technology, as well as participants in the Portuguese and Spanish Nanotechnology Networks.

This document emphasized initially a few multidisciplinary strategic research areas, on which the first efforts of the INL will focus. The specific projects within these areas will be defined in a greater detail at a later stage, considering the scientific needs of Portugal and Spain and the international state-of-the-art of nanotechnology.

Spanish and Portuguese Nanotechnology Initiatives

Spain

There are several Spanish activities concerning Nanotechnology and Nanoscience implementation, either through the creation of virtual centers, or through the creation of real research infrastructures. The following initiatives are emphasized: in Madrid (3; ISON, Nicolás Cabrera, Microelectrónica), in Catalonia (3: Nanobio, Ciencias Fotónicas, Nanotecnología), in Aragón (1: INA), in Valencia (3: Instituto Fotónico, Instituto Molecular, Instituto Catálisis), in País Vasco (2: Donostia International Physics Center, CIN Biogune), in Asturias (2: Instituto Nanociencia, Instituto del Carbón), and in Galicia (1: Red Gallega de Nanotecnología). Most of these centers participate in the Nanospain Network that incorporates most of the researchers active in this field, with almost 200 groups involving more than 1200 researchers. Among the topics covered, nanomaterials (with important activity in nanoparticles) concentrate about 60% of the efforts, followed by nanoelectronics (with important activity in molecular electronics, nanomagnetism and spintronics) and nanophotonics, nano-(chemistry/ biochemistry), nanomedicine. Most of these groups are located in Madrid and Catalonia. The rest of the high-level groups are dispersed all along the other Spanish Autonomous Communities.

The distribution of this research activity among the different centers in Spain is very heterogeneous: 55% of the activity related to nanotechnology depends from universities. 28% depend from the Spanish Research Council (CSIC), 9% from industry, 4% from technology centers, 3% from foundations and 1% from other kinds of centers.

Regarding financing, the activities are mainly supported by European funds, national, and regional Ordinary Programmes: MAT, FIS, TIC. On the other hand, it has recently been launched the first specific action for nanoscience and nanotechnology: the Strategic Action in Nanoscience and Nanotechnology, by the Ministry of Science and Education, which turned out to be a very competitive program. In this Strategic Action for Nanoscience and Nanotechnology, the most competitive Spanish groups were active in the following areas: Nanomanipulation & Nanoscale control; Biomedicine & Nanoparticles; Photonics & Nanoelectronics; Nanotechnology & Nanomaterials for Energy conversion and storage. These are presently the most relevant areas for the research groups in Spain.

Portugal

In Portugal, activities in the Nanoelectronics, Nanomaterials, and Nanobiotech areas exist centered in Lisbon, at Instituto Superior Técnico and INESC MN (nanofabrication, nanoelectronics, nanobiotech, and electronic nanomaterials), at the Chemical and Biological Engineering Department of Instituto Superior Técnico, Technical University of Lisbon (nanobiotech, colloids, membranes), and at the Universidade Nova de Lisboa (thin film electronics, microfabrication). In the North of Portugal, activities exist at the University of Porto (mostly in the biomedical area, biomedical materials, and physics of nanomaterials), and at the University of Minho in Braga (regenerative medicine materials) and in Guimarães (nano polymer engineering). Ceramic nanocomposites, photonics, and molecular materials are leading research themes at the University of Aveiro. Top down technologies are essentially centered at the Clean Room facilities at INESC MN in Lisbon, and to a lesser extent at Universidade Nova de Lisboa. Most of these groups are now involved in two Associated Laboratories in Nanoscience and Nanotechnology that were created within the Portuguese Science and Technology Foundation, respectively INN (Institute for Nanoscience and Nanotechnology) and I3N (Institute for Nanomaterials, Nanosciences, and Nanotechnologies). The Nanobiotechnology and Nanomedecine area is also covered in the recently created IBB (Institute for Biomaterials and Bioengineering) Associated Laboratory. The ceramic nanomaterials area is mostly covered by the Associated Laboratory CICECO —Research Center in Ceramic and Composite Materials, at Aveiro University. The majority of these centers participate in the Portuguese Nanotechnology Network that incorporates most of the researchers active in this field.

The rationale for the creation of the INL

In summary, the scientific level of Portugal and Spain is internationally competitive from an individual point of view, but it lacks specific weight, i.e, there is need for a critical mass beyond the main nuclei (Madrid, Lisbon) to be internationally relevant at a higher level. Thus, the INL aims at being a common point of reference for the excellent groups of the Iberian Peninsula.

On the other hand, most of these groups are working on Nanoscience, only few of them on Nanotechnology. This is one of the main weaknesses of the Iberian Peninsula: good academic level but with few results on the practical side, the contrarily to other European countries, USA and Japan. The INL also aims at boosting Nanotechnology, trying to increase practical applications, collaborating with already existing companies as well as stimulating the creation of new spin-off companies. Of course, the fundamentals of Nanoscience will be useful for this strategy.

Finally, the INL will offer new equipment, not existing in many of the Portuguese and Spanish laboratories, and will try to complement the already existing instrumentation of both countries.

Priority research areas

The choice of priority research areas is critical. This choice is based on strategic areas recommended by the International Advisory Board, but also on the existing current areas of excellence in Nanoscience and Nanotechnology in Spain and Portugal and on needs identified in the economical tissue of both countries. Based on these criteria the following priority research areas were selected:

Nanomedicine

The focus of this theme is the study, design and fabrication of nanoscale structures and devices for the diagnosis, treatment, and prevention of diseases and genetic disorders. Advanced health technologies will be key drivers of the technological development as the population in developed countries ages and as the full impact of the genome and proteome research becomes available. Nanomedical nanostructures will include: in-situ nanodevices for drug delivery; nanoparticles for selected cell destruction (e.g., hyperthermia in cancer treatment), imaging and diagnostic; biochip platforms for bio-molecular recognition applied to genetic disease diagnosis; DNA, protein and cell-chips; micro and nano-electrodes for neural and cortical implants; neuroelectronics; new biomedical imaging tech-nologies (miniaturized NMR, MRI); and improved MEG and MCG systems.

This theme has a strong societal impact, and will stem from interdisciplinary research between existing teams of engineers, biologists, physicists, physicians, chemists, and others. A strong connection to bioengineering departments and medical schools of major universities, as well as to companies operating in the biotech, medical and pharmaceutical fields will ensure that the

research carried out at the INL will have impact both in the education and in the industry.

Environment monitoring and security and food quality control

This research theme will involve developing point-of-care micro and nano systems targeted at food quality control, at environmental quality analysis (air, water, and soil), as well as at conventional and nuclear explosives, and at other bioterrosim detection. These are areas of great societal concern and enormous economical impact, as developments therein can be quickly brought into production and into the market. A Portuguese and Spanish industrial cluster of excellence in these areas has to be envisaged in the near future. This is particularly relevant as the respective research potential has not yet been explored in both countries. Seed industries related to the wine, fishing, cheese and olive oil production, as well as coastal water quality monitoring could become global technological leaders.

The development of micro and nano systems for environment monitoring and security, and for food quality control incorporates at a first stage nanotransducer design and fabrication. These transducers will include micro and nano electromechanical systems (MEMS and NEMS), and advanced single/few molecule transducers (based on spintronic, photonic, and electronic detection principles). These transducers will include necessarily chemically and biologically sensitive layers for specific detection of chemical and biochemical signals. In addition to the transducer development, in a second stage, full sensor systems capable of amplifying, conditioning, processing, transmitting and displaying the transducer signal will be a focus of research at INL. The application spectrum is wide, and the immediate societal impact easily recognizable. Interdisciplinary connections with food and environmental engineers, as well as with electrical engineering and computer science Departments will ensure the impact of the INL research.

Nanoelectronics (beyond CMOS)

The focus of this area will be the development of technologies and devices in the "beyond CMOS" area. The electronics industry is the largest industry in the world. Competing directly with the installed infrastructure ("more CMOS") is deemed impossible due to the enormous amount of financing required. Nevertheless, there is an open opportunity in the development of electronic devices (semiconductor, magnetic, or photonic based) that incorporate novel materials, and unconventional structures, for application in non-commodity products, mostly in the sensor application field. The combination of electronics, photonics and nanoscale materials is an emerging area that presents a unique opportunity for the research community to influence the future of technology. Fabrication of 2D and 3D photonic crystals cannot only allow the manipulation of light, but also contribute to design novel optical fibers, lasers, etc., with new sensing capabilities.

These new nanoelectronic systems are required to support the previously defined strategic areas (Nanomedecine, Environment Security and Food Quality Control). These novel devices will include merging various state-of-the-art device and sensor technologies (spintronics, NEMS and MEMS, micro- and nanofludics, optical and semiconductor based devices) in multifunctional microsystems and lab-on-chip platforms targeted at the abovementioned strategic themes. In addition, novel nanostructures such as carbon nanotubes, single molecules, nanowires, nanoparticles and quantum dots can be incorporated in these platforms.

In a first stage, the Nanoelectronic devices will support applications in Biotechnology and Medicine, as well as in Environmental and Food Monitoring. In a second stage, it is envisaged that the nanoelectronic modules developed can be commercialized as such for incorporation in other products, thus establishing the basis for new start-ups in the nanoelectronics area seeded by the INL.

Nano-machines and nanomanipulation

The INL considers strategic an activity of basic "blue-sky" research on nano-machines and micro-robotics. The objective of the INL is to become one of the leaders in this field of research. Nanomachines are systems that can have a combination of mechanical, sensorial, electronic, computational and communication functions with a size of at most a few tens of micron (the width of a human hair). Another example is "smart dust", where systems of the size of dust particles can be used for extremely large scale disseminated monitoring.

This area of activity will encompass microfabricated NEMS structures (such as nanoactuactors, nanosensors, nano-fuel cells) targeted at single/few molecule detection and/or manipulation. The area also covers the design, synthesis and operation of molecular objects (using self assembly, biomimetic chemistry), and of instruments required to interact with these single molecule structures (such as miniaturized magnetic and optical tweezers). Externally modified self-assembly will be also a key point toward the fabrication of devices using nanoparticles as building blocks. Of major interest is the design of molecular bio-electronic devices merging the

physical principles of electronics and computer engineering with the functional and structural principles of biology.

Another possible line of activity concerns the development of sensor/actuator networks at the nanoscale for applications in cellular and molecular systems, first in vitro and later in vivo. This involves developing sensors, actuators, computing, communications, all at the nanoscale, and building an integrated system with a particular functionality or mission (cell signaling, therapy, etc.). This activity is strongly connected with the priority areas of nanomedicine and nanoelectronics.

Societal impact of nanotechnology

A crucial part of the mission of INL will be: (i) to enhance the public awareness of nano science and technology, and (ii) to address the ethical, social and environmental impact of nanotechnology. The INL will at all times drive a strong program in public outreach, popularizing nanoscience and strategic nanotechnology, approaching mass media, science and technology museums, foundations, and publishers.

Public outreach, both to increase public knowledge about nano science and technology, but also to stimulate the young towards science and technology in general, will be an important task of INL. An outreach office will be established, which will form strong connections with schools, universities, and science museums, and collaborate in their activities. INL researchers will be encouraged to dedicate some of their time to the community, in the form of off-site talks, laboratory visits, and demonstrations. INL will hold "open-days", during which both scheduled and spontaneous visits to the Laboratory will be held.

Addressing the ethical, social and environmental impact of a technology with the disruptive potential of Nanotechnology is essential. This will be made through the establishment of protocols with social science and environmental departments of major universities. These agreements will put in contact nano science and technology researchers, who will be mostly engineers, chemists, physicists or biologists, with social scientists and environmental engineers. These teams will be able to have the necessary technical expertise to tackle all the complex issues involved.

The scientific infrastructure

The scientific infrastructure will contain central laboratories (providing services for the INL resident research personnel and visiting scientists) and specialized dedicated laboratories associated with individual PIs or research groups and topics. The central facility will be unique in the Iberian Peninsula in what concerns state of the art nanofabrication and characterization facilities. The dedicated laboratories will further strengthen the world wide competitiveness of the research environment. Besides state of the art instrumentation (so called Class 1), the INL will also promote the implementation of Class 0 instruments, that is new instruments with unique capabilities not available anywhere in the world. For instance development of nano and micro sensor based setups to address individual nanoparticle properties. The main central facilities will be described next.

Central Micro and Nanofabrication

The Clean Room (around 500m2, class 100 and class 10) will be based on dedicated direct-write e-beam tools capable of 10 to 20nm feature definition. One of the e-beam tools should allow Electron Beam Induced Deposition and Etching. A dual beam FIB system will also provide sample inspection and nanofabrication capabilities. The clean room will include standard deposition tools (multitarget PVD for metal deposition, CVD for oxide and semiconductor deposition), reactive ion etching (metal and oxide), planarization (CMP), and thin film characterization tools (thickness monitor, spectral ellipsometer), ion miller, RTA+ovens, and other equipment required for small scale prototype and device fabrication on wafer sizes not to exceed 4". A small packaging unit will be formed to dice, wirebond and package various types of devices. The central facility will also incorporate a microfluidics unit (mask aligner, thick resist (SU8), PDMS, and electroplating processing equipment). INL will collaborate with other existent clean room facilities when larger wafer dimensions are deemed needed.

Central Scanning Probe Microscopy Laboratory

This laboratory will support SPM activity from standard imaging to advanced applications and development of new techniques. A small number (2, expandable as needed) of standard SPMs will be available for regular imaging.

Additionally an advanced facility, especially intended for biological/ biochemical applications, will provide SPM coupled with confocal optical microscopy. There will also be one SPM especially intended for the development of new techniques, supported by standard test and measurement equipment. This laboratory will have acoustic and vibration insulation systems as required for SPM.

Central Biology and Biochemistry facility

This facility will provide support for groups developing biology and biochemistry activity. It will provide equipment for FPLC/HPLC protein purification, spectrophotometry/ nanochop, mass spectrography with gas chromatography, flow cytochemistry and cell sorting, real-time PCR, confocal microscopy and centrifugation (ultra and low-speed) and cell culture. The facility will also include the necessary supporting infrastructure, as optical and fluorescence microscopes, -4ºC, -20ºC and -70ºC chambers and freezers, a dark room, a sterile chamber with laminar flow, extraction benches, and a washing and sterilization facility for laboratory material. The possibility of future installation of secure areas needed for bio-hazard work will be contemplated.

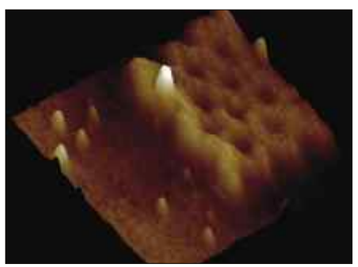
Central Structural and Interface Characterization Laboratory

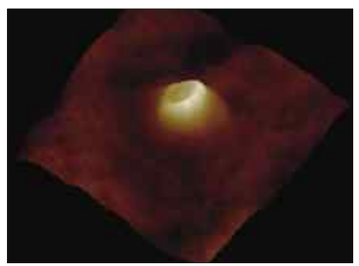
This laboratory will allow in-house detailed structural characterization of thin films, interfaces, and nanostructures. The following techniques will be installed (not exclusive): HRTEM and SEM (combined with SPM and microanalytical tools), X ray (small angle, single crystal and powders, high/low temperatures, etc.), interface and surface analysis (SIMS, Auger, XPS.).

The dedicated laboratories will be associated with particular PI needs, and topical needs (spintronics, NEMS, photonics, high frequency device characterization, nanomaterial synthesis labs, etc...).

Funds will be set apart from the beginning to account for these particular infrastructures. Equipment requirements will be discussed with the new PIs as part of the hiring process in order to offer a highly competitive package to attract leading scientists, teams, and young researchers in the designated priority areas.

Ultimately the Laboratory facilities should accommodate around 400 people (200 scientists, 100 research students, supplemented by technicians, administrative personnel and others). The work space needed, together with support areas (library, meeting rooms, auditory), a residence for up to 50 students and 20 visiting scientists and premises for start ups are estimated to reach a total area of about 15,000 m2.





Legal Framework, Governance and Administrative Issues

Building on Expert Advice

The preparation of the legal framework and governance structure for the International Iberian Nanotechnology Laboratory (INL) was asked to Jean-Marie Dufour, then Professor at the Law School of the University of Geneva and President of the Geneva International Academic Network.

Professor Dufour was a legal advisor of CERN —European Organization for Nuclear Research at Geneva, Switzerland, founded in 1956, and was involved in the creation of the main international research laboratories in Europe, namely ESO —European Southern Observatory with headquarters at Garching, Germany that also houses the joint ESO/ESA European Coordination Facility for the Hubble Space Telescope and with facilities also in the La Silla Paranal Observatory in Chile, where it operates the VLT —Very Large Telescope and the VLTI —Very Large Telescope Interferometer, created in 1962, EMBL —European Molecular Biology Laboratory at Heildelberg, inaugurated in 1978, and ESRF —European Synchrotron Radiation Facility at Grenoble, France, created in 1988.

The analysis of the main Administrative Issues was requested to Mr. Helmut Krech. Mr. Helmut Krech is Head of Administration of the ESRF —European Synchrotron Radiation Facility at Grenoble, France, which was created in 1988.

The Initial Steps

Steadily Preparing the Future

In November 2006 the Portuguese Council of Ministers approved the creation of a not-for-profit private association of public interest to prepare the installation of INL. The members of the association are, from the Portuguese side, the Ministry of Science, Technology and Higher Education, through the Science and Technology Foundation, and the Knowledge Society Agency, and, from the Spanish side, the Ministry of Education and Science, through the Secretariat-General for Scientific and Technological Policy. These four entities comprise the General Assembly of the Installation Commission. The aim of the Installation Commission, formally created on March 19, 2007 with the publication of a Portuguese Decree-Law, is to develop the physical infrastructure of the INL and to hire its initial staff. It will be operational during the period in which the legal procedures necessary for the advent to of the INL as an international institution are put into effect by both countries. The administration of this new entity, Jose Rivas Rey, Carlos A. Bernardo and Paulo P. Freitas, started working immediately with a view of having the INL fully operational by 2010.

In November 2006, at the PortugalSummit, held in Badajoz, the heads of both governments signed the International Convention regarding the creation of the INL as an international body to be located at Braga and its statutes. These anticipate the possibility of opening the new international organization to the membership of other countries and to the participation of institutions and experts of all the world, with the objective of establishing an international research pole of excellence, developing partnerships with higher education institutions and industry, transferring knowledge with added value, generating employment and training specialized professionals.

In the same day of the 2006 PortugalSummit, the Science and Technology Foundation of Portugal, and the Directorate-General of Research of Spain jointly launched a call for R&D projects in nanotechnology, in connection with the INL, in the framework of the scientific and technological cooperation agreement between both countries. This call was specifically addressed to the following themes: nanomedicine (diagnosis systems, therapeutical applications and drug delivery) and nanotechnology for environmental control and for food safety and quality. It was open to international multidisciplinary teams, but necessarily involving at least a research team from both Spain and Portugal. The evaluation of the projects submitted to the call was done by an independent international panel of experts selected by common agreement between both organizations. It was the first time that the two countries adopted such a scheme for the evaluation of bi-lateral cooperation projects.

In February 23, 2007, at the headquarters of the Installation Committee of the INL, in Braga, took place a meeting a meeting that brought together for the first time the leaders of the main nanoscience and nanotechnology laboratories of Portugal and Spain, including also the coordinators of the national nanotechnology networks and representatives of the ministries of science of the two countries. In this meeting, the various centres were presented and the role of INL in Iberian nanotechnology research was discussed.

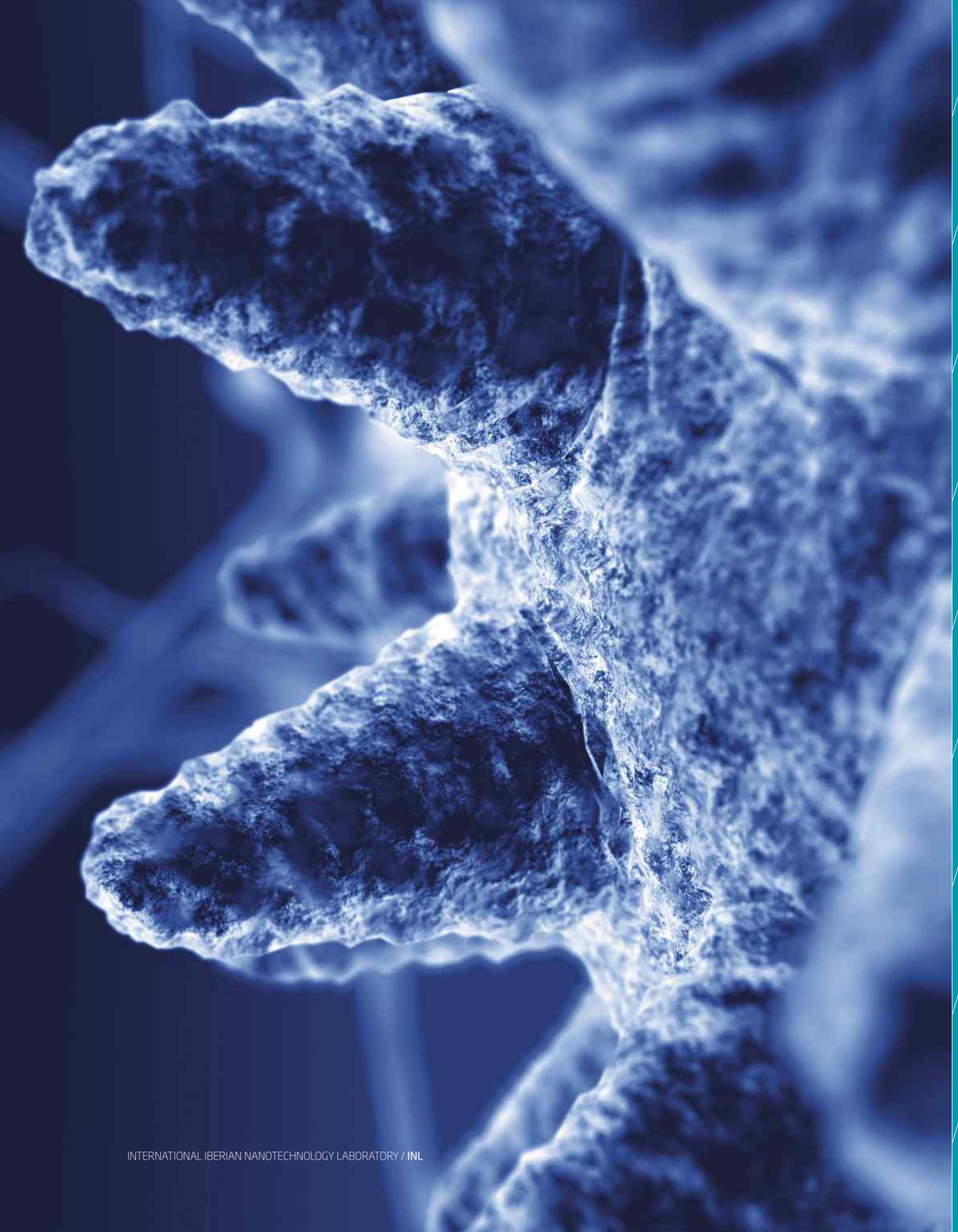
In July 27, 2007, the second General Assembly of the Installation Commission of the INL took place, to decide upon the proposal of the Administration Council to adjudicate the BoD (Basis of Design) of the future campus and buildings of the INL. Based on the report presented therein, it was decided to assign the development of the BoD, in parallel, to two firms of the highest international standing in the design of installations for nanoscience and nanotechnology research. These firms, M+W Zander and HDR (Henningson, Durham & Richardson International, Inc), have headquarters in Germany and the USA, respectively, and operate worldwide. By commissioning two parallel studies, the INL created a natural competition between two highly qualified design teams, thus enhancing the probability of obtaining two solutions of the highest caliber. At the end of 2007 one of these solutions will be selected, and international public tenders for detail design and construction will take place based upon it.

Throughout 2007, the necessary legislative process for approval of the international Convention signed between the governments of Portugal and Spain in their 2006 Summit followed due procedure in both countries. The Convention was discussed and approved in the parliamentary assemblies of both countries and was recently promulgated by the two heads of state.

In September 2007, the President of the Board of Management of the Installation Commission of the INL, José Rivas, invited the main nanoscience and nanotechnology laboratories of Spain and Portugal to participate in a program to train young post-graduates at doctoral level financed by the INL. In early 2008, a programme directed to the further training of post-docs will also be opened. These post-docs will be involved in R&D training programs in selected strategic areas, in partnership with international institutions. Part of these programs will be carried out at the INL, as the scientific infrastructure becomes available

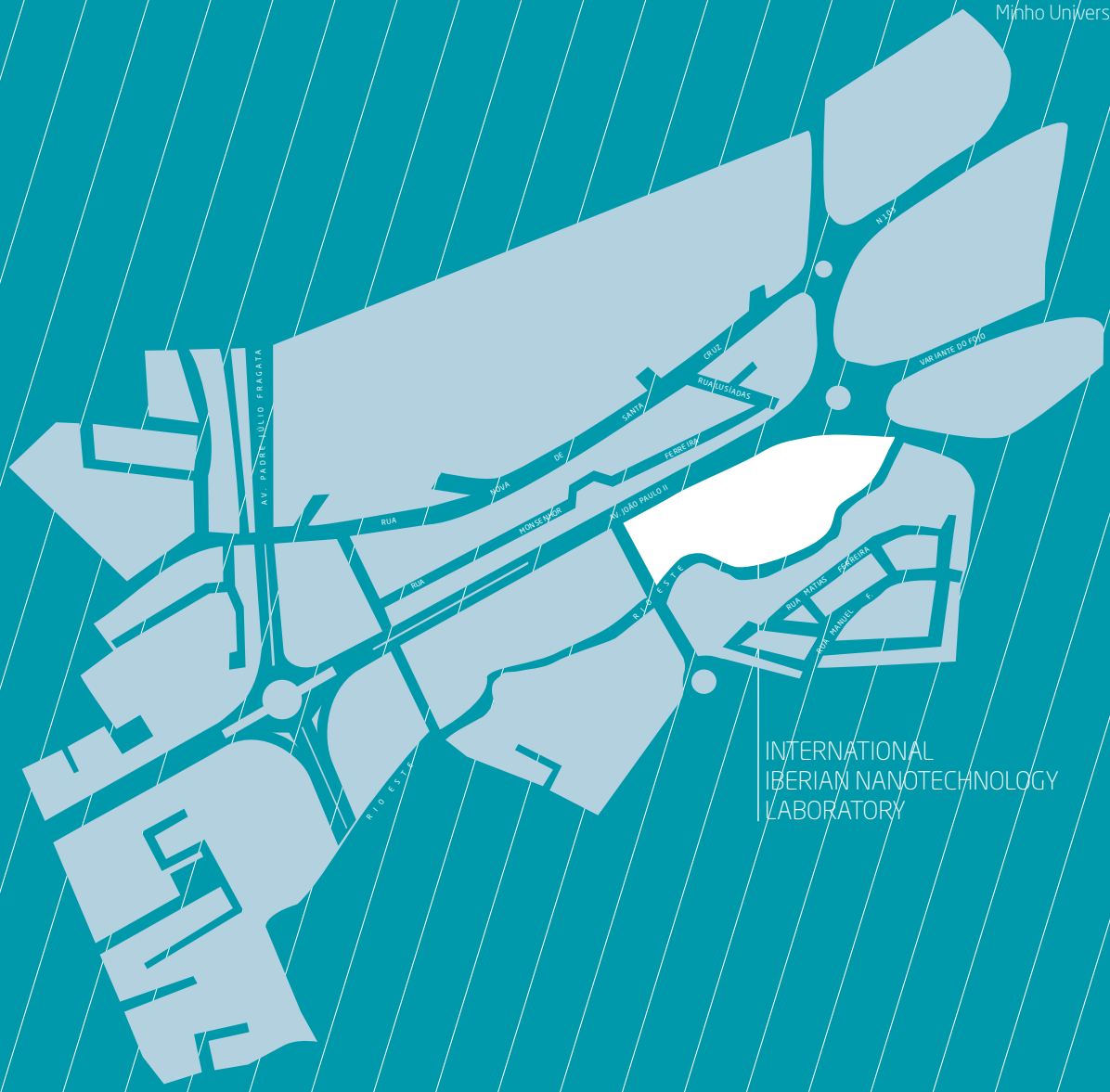
In December 3, 2007 the International Advisory Board of the INL will convene to appreciate the activities of the first year of the Installation Commission, namely the human resources strategy, the further definition of the research areas and the development of the physical infrastructures.

With these steps the International Iberian Nanotechnology Laboratory hopes to become an attractive community for nanotechnology research in the Iberian Peninsula and worldwide, and a dynamic link in the scientific cooperation between Portugal and Spain.



INTERNATIONAL IBERIAN NANOTECHNOLOGY LABORATORY / **INL**

Future site of the
International Iberian Nanotechnology Laboratory



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